

## METHOD AND DEVICE FOR THE AIR-CONDITIONING OF A FREIGHT COMPARTMENT OR A CABIN OF AN AIRCRAFT

The present invention relates to a method and a device for the air-conditioning of a  
5 freight compartment or a cabin of an aircraft.

According to the latest prior art aircraft cabins are for example air-conditioned in such a way that temperature-controlled mixed air is blown into the cabin in the upper region of the cabin, i.e. in the roof region. The term "air-conditioning" covers in this case not  
10 only in the narrow sense the adjustment of the temperature and atmospheric humidity conditions but also the adjustment, in particular regulation, of the important parameters of the injected air, in particular therefore its temperature. This applies also to the invention described herein.

15 In modern aircraft the so-called mixed air blown into the cabin is normally composed of three components, namely so-called recirculated air, temperature-controlled fresh air, and so-called propulsion fuel air. Recirculation air is air from the cabin or from the freight compartment that is reused. The treatment of recirculation air and fresh air is known as such from for example DE 199 36 643 A1. In the prior art the temperature of  
20 the fresh air is normally adjusted to the lowest level of all connected fresh air users (i.e. the units in the aircraft that use fresh air). In order to achieve a desired temperature in the cabin, the inflowing mixed air is admixed, depending on the temperature requirements, with a regulated amount of propulsion fuel air. In the prior art the temperature-regulated mixed air is fed via a plurality of lines that lead to different sites  
25 in the cabin, wherein the mixed air blown in at the different sites into the cabin (or freight compartment) is in each case at a temperature that is adjusted or regulated to the same value. Such methods and devices for the air-conditioning of aircraft cabins are for example also known from DE 196 42 203 C1 and US 4,741,255.

30 The known methods and devices for the air-conditioning of aircraft cabins or freight compartments experience difficulties in ensuring a good thermal comfort for the passengers, particularly if the cabin walls have widely varying thermal properties, i.e. in particular fairly large differences in thermal conductivity. Such relatively large differences in thermal conductivity occur in particular between the cabin floor and the  
35 cabin side walls.

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The object of the invention is to provide a method and a device for the air-conditioning of a freight compartment or the cabin of an aircraft, by means of which a high thermal comfort for the passengers as well as a good air quality can be achieved. In order to  
5 obtain a sufficient air quality a specific minimum air throughput is necessary. The air quality is measured in particular by the carbon dioxide and carbon monoxide levels, atmospheric humidity, as well as the concentration of harmful substances.

To achieve this object the method according to the invention for the air-conditioning of  
10 a freight compartment or a cabin of an aircraft envisages that simultaneously at sites remote from passengers air that is at a temperature different from that at sites closer to passengers is introduced into the freight compartment and/or the cabin.

The sites closer to passengers in the above sense are located in the floor region and the  
15 sites remote from passengers are located in the roof region of the cabin. The temperature difference between the air blown in close to passengers and remote from passengers depends on the instantaneous temperature conditions, and in particular on whether the passenger compartment has to be heated or cooled. A cooling of the passenger compartment has great practical significance. If a cooling of the cabin is  
20 necessary, then overall cold air has to be blown in, though of course the passengers should not be directly subjected to very cold air. Accordingly, according to a preferred modification of the invention, in the case of a necessary cooling somewhat warmer air is blown in at positions close to passengers than at sites remote from passengers.

25 In the case of a necessary heating of the cabin a similar procedure is preferably adopted: in order not to subject the passengers directly to a relatively hot stream of air, under these conditions somewhat hotter air is preferably blown into the cabin at sites remote from passengers than at sites closer to passengers.

30 The line system according to the invention for the air-conditioning of a freight compartment or a cabin of an aircraft envisages at least first and second line branchings via which air at different temperatures can be fed on the one hand to sites

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remote from passengers and on the other hand to sites of the freight compartment and/or cabin closer to passengers.

According to a further preferred modification of the invention the mixed air, which may  
5 be composed as desired of three components and which is introduced into the cabin and/or the freight compartment, is fed through basically two feed lines into a line system. One of the feed lines conveys, as required, temperature-controlled fresh air and recirculated air. The other feed line conveys, as required, a larger or smaller amount of hot propulsion fuel air.

10 The different air temperatures in the aforementioned first and second line branchings are achieved in a simple way with control means, for example a valve, which adjusts the ratio of the propulsion fuel air to fresh air and recirculated air in the first and second line branchings.

15 The invention provides in particular for the wellbeing of passengers if the freight compartment of a transport aircraft is also used in order to carry a larger number of persons. The wellbeing of the passengers is also achieved in this case if the floor is, on account of the poor thermal insulation capacity, relatively cold compared to the side  
20 walls. Compared to the prior art the wellbeing of the passengers is also achieved by the invention on account of the fact that their comfort is not adversely affected by air that is too hot in the floor region. By means of the invention a uniform temperature and flow speed distribution of the air in the freight compartment and/or cabin is achieved and the uniform temperatures of the walls surrounding the passengers raise  
25 the so-called thermal comfort. At the same time the invention provides for a good air quality by means of an air throughput necessary for this purpose. One embodiment of the invention is described in more detail hereinafter with the aid of the drawing.

The figure shows diagrammatically an aircraft and a line system for the air-conditioning  
30 of a freight compartment or a cabin in the aircraft. The diagrammatically illustrated aircraft 10 has freight compartments 12, 14. A larger number of passengers can also be conveyed in the freight compartments 12, 14. As a variant of the illustrated example of implementation, instead of the freight compartments cabins too can be air-

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conditioned in a similar way with the line system described in more detail hereinafter. The freight compartments 12, 14 have in each case a floor region 18 and a roof region 20.

- 5 The line system illustrated in the figure for feeding mixed air into the freight compartments 12, 14 also serving to carry passengers has a first line branching 22, 24 that leads into the roof region 20.

A second line branching 26, 28 leads into the floor region 18. A feed line 30 comes  
10 from a mixing chamber (not shown), in which temperature-controlled fresh air and recirculated air are mixed. The arrow shows the flow direction in the feed line 30.

Another feed line 32 conveys hot propulsion fuel air.

- 15 The temperature-controlled air adjusted by sensors and a regulating device known *per se* is blown from the first line branching 22, 24 through pipes A, B extending in the longitudinal direction of the cabin, into the freight compartment or the cabin. For this purpose the pipes A, B have openings regularly distributed over their length for the outflow of air.

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The temperature-controlled air conveyed through the second line branching 26, 28 is blown through pipes C, D into the freight compartment and/or the cabin, wherein the pipes C, D in the floor region 18 likewise extend in the longitudinal direction of the cabin and have openings.

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- If the cabin has to be cooled on account of the ambient conditions, then air is blown in through the pipes A, B laid remote from the passengers that is somewhat cooler than the air blown in through the pipes C, D, in order to prevent the passengers being subjected to an unpleasantly cold stream of air, with possibly the accompanying danger  
30 of catching cold.

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The individual temperatures to be adjusted of the air leaving the openings in the pipes A, B, C and D are set as desired by the control system, depending on the ambient conditions. The temperature adjustment is performed as follows:

- 5 The hot propulsion fuel air introduced through the feed line 32 into the line system is split into two line branches 38, 40, in which are arranged valves 34, 36 that can be controlled as regards the air throughput. The hot propulsion fuel air controlled by means of the valve 34 passes through lines 42 and 44 into the two lines 22, 24 of the first line branching. In other words, the supply of hot propulsion fuel air to the first line  
10 branching 22, 24 is adjusted via the valve 34.

The hot propulsion fuel air flowing through the adjustable valve 36 passes through lines 46, 48 into the two lines 26, 28 of the second line branching. The temperature of the air blown through the second line branching 26, 28 into the floor region 18 is thus  
15 adjusted by the setting of the valve 36.

If one of the valves 34 or 36 is opened further, the throughput of hot propulsion fuel air in the relevant first or second line branching is raised and the temperature of the mixed air blown out through this line branching is thus also increased. Sensors for the  
20 temperature measurement in the freight compartments or cabins are known as such and may be used according to the prior art. Likewise, the equipment for obtaining fresh air and its temperature regulation as well as the equipment for recirculating the cabin air before the latter is fed through the aforescribed feed line 30 to the line system according to the invention, are also known. The same applies as appropriate to  
25 the necessary temperature sensors and computer-controlled regulation device by means of which the necessary temperatures of the air that is blown in are regulated. The regulation is governed by various parameters, such as for example the desired internal temperature in the freight compartment or the cabin, the external temperature, and the cabin occupancy. Depending on this, the air blown out in the floor region 18 through  
30 the openings in the pipes C and D will have a temperature that is a few degrees centigrade lower than the air in the roof region 20 blown in from the openings in the pipes A, B. However, if the temperature in the freight compartment or in the cabin is to

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be raised compared to an actual value, then the air blown out in the floor region 18 as a rule has a higher temperature than this actual value.

If on the other hand the temperature in the freight compartment or cabin is to be  
s reduced compared to an actual value, then the air blown out in the floor region 18 through the openings in the pipes C and D will have a temperature that is a few degrees centigrade higher than the temperature of the air in the roof region 20 blown in from the openings in the pipes A, B. The air blown out in the floor region 18 and in the roof region 20 then has a lower temperature than the actual value.